

Report on principal results on aims of work under NASA Grant
NSG-517 in the Department of Pathology, University of
Minnesota, during the span from July 1, 1965 to December
31, 1965

1. It was demonstrated by so-called least squares spectra that a number of rhythms with small amplitude and a frequency much lower than circadian characterize the 17-ketosteroid excretion of a healthy human being. Pertinent results are summarized in a monograph now in press as a Supplement to the Acta Endocrinologica under the title "Spectral resolution of low-frequency, small-amplitude rhythms in excreted ketosteroid; probable androgen-induced circaseptan desynchronization".

2. The above monograph also introduces several new electronic computer techniques specifically developed for the study of amplitude and phase relations of rhythms, and such techniques have been tested in further applications to various circadian rhythmic functions as well. The techniques have been presented at the 5th Acta Endocrinologica Congress in Hamburg in a paper entitled "Electronic computer techniques for the study of endocrine rhythms". Applications of results are also reported in:

Stephens, G. and F. Halberg: Methodologic aspects of human time estimations with special reference to 24-hour synchronized circadian rhythms. Nursing Research 14, No. 4: 310-317, 1965.

Halberg, F.: Organisms as circadian systems; temporal analysis of their physiologic and pathologic responses, including injury and death. In Walter Reed Army Institute of Research Symposium, Medical Aspects of Stress in the Military Climate, April (1964), 1-36. (just off the press)

Haus, E. and F. Halberg: Circadian phase diagrams of oral temperature and urinary functions in a healthy man studied longitudinally. Acta Endocrinologica, in press.

Halberg, F. and C. J. Falliers: Variability of physiologic circadian crests in groups of children studied "transversely". Pediatrics, in press.

Frank, G., F. Halberg, R. Harner, J. Matthew, E. Johnson, H. Gravem and V. Andrus: Circadian periodicity, adrenal corticosteroids, sleep deprivation, and the EEG in normal man. J. of Psychiatric Research, in press.

Haus, E. and F. Halberg: Persisting circadian rhythm in hepatic glycogen of mice during inanition and dehydration. Experientia, in press.

Siffre, M., A. Reinberg, F. Halberg, J. Ghata, G. Perdriel and R. Slind: Etude de deux sujets adultes sains avant, pendant et après leur isolement souterrain prolongé. Prepared for publication.

Reinberg, A., F. Halberg, J. Ghata, M. Siffre: Spectre thermique (rythmes de la température rectale) d'une femme adulte saine avant, pendant et après son isolement souterrain de trois mois. Prepared for publication.

3. In work on the mouse, the pituitary adrenocorticotrophic rhythm and a hypothalamic CRF rhythm have been summarized in terms of their amplitude and timing by the so-called cosinor technique, and most interestingly it was found

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that the hypothalamic CRF rhythm lags in phase by about a quarter cycle behind the pituitary ACTH rhythm, a finding that suggests, even though it does not prove, that the hypothalamus might modulate the circadian periodic adrenal cycle while it does not necessarily initiate it in the undisturbed animal, shielded as far as possible from environmental stimuli other than the alternation of light and darkness on a 24-hour cycle.

4. The above mentioned cosinor technique has also led to the quantification of the amplitude and phase of a number of rhythms in human blood and has provided confidence intervals for such amplitude estimates and confidence arcs for the phase estimates. The same technique also serves to detect a number of heretofore not known circadian rhythms in human blood, included in a table attached to this report.



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